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PHYCOLOGICAL CONTRIBUTIONS
I

BY
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Growing on rocks along high-tide level. In the vicinity of San Francisco, California. Type no. 4444, Gardner.

Ulva californica Reed, Two ascomycetous fungi, etc., 1902, p. 149 (not of Wille).

Ulva vexata has been observed only in the vicinity of San Francisco, as mentioned above, where it grows in considerable profusion. It seems quite probable that it may be much more widely distributed both north and south of San Francisco. It might be suspected of being a malformation due to the parasite always found more or less infesting it, but the size and proportions of the cells of the less parasitized portions seem to mark it as a distinct species.

Ulva angusta sp. nov.

Plate 27 and plate 31, figure 1

Thallo simplici aut rarissime lobato, lanceolato aut oblanceolato, 8–15 cm. longo, 0.5–1.5 cm. lato, 35–45μ (interdum prope 53μ) crasso, basi aut longe abrupto ad stipitem delicatum solidumque attenuato, disco affixo, dilute viridi, marginibus fere planis usque ad crispatissimis; cellulis e superficie 3–6 lateralibus angulis rotundis, 5–12μ diam. sectione transversali quadratis ad 1.5-plo longioribus, angulis rotundis; chromatophoris dimidium externum cellularum implentibus; pyrenoidibus singulis.

Frond simple or very rarely lobed, lanceolate to oblanceolate, 8–15 cm. long, 0.5–1.5 cm. wide, 35–45μ thick (occasionally about 53μ), tapering either gradually or abruptly at the base to a delicate, solid stipe with discoid holdfast, color of fronds pale green, margins varying from almost plane to very much crisped; cells in surface view 3–6 sided, with rounded angles, 5–12μ diam. in section, quadrate to one and a half times longer than broad, with rounded angles; chromatophore filling the outer half of the cell; pyrenoid single.

Growing in shallow pools along high-tide level. Moss Beach, San Mateo County, California, April, 1919. Type no. 4430, Gardner.

We find at several places along the coast of central California a rather short and narrow *Ulva* which does not seem to belong to any of the hitherto described species. We have felt compelled, therefore, to give it a name. It resembles the *Phycoseris lapathifolia* of Kuetzing (1856, pl. 25), but is shorter and narrower. It also resembles, even more closely, Kuetzing's figure of *Phycoseris Linza* (1856, pl. 16, fig. 1), but is a smaller plant than that also. The short, flattened stipe is solid. The narrow blade varies from plane to undulate or even crisply ruffled on the margins. The cells are oblong or rounded in section, each provided with a more or less distinct wall. Although we have only recently become acquainted with it, this seems to be a vernal species. It has been observed in fertile condition in April.

Ulva lobata (Kuetz.) comb. nov.

Phycoseris lobata Kuetzing, Spec. Alg., 1849, p. 477, Tab. Phyc., vol. 6, 1856, p. 10, pl. 27.

Ulva fasciata f. *lobata* Setchell, *in* Collins, Holden and Setchell, Phyc. Bor.-Amer. (Exsicc.), no. 863; Collins, Green Alg. N. A., 1909, p. 216.

Among the *Ulvae* of the Californian coast is one of moderate size (up to 30 cm. or more long, and up to 15 cm. or more broad) which is distinct in general appearance. It is attenuate at the crisped base, broadening above and usually lobed or divided into several broad divisions. The margins are either plane or slightly undulate. Like *U. expansa* it is thicker in the center with palisade-like cells (in section) and thinner on the margins where the cells are nearly square (in section). It bears a striking likeness in every way to Kuetzing's figure (1856, pl. 27) of his *Phycoseris lobata* from Chili. We have, therefore, referred it to his species with some doubt.

Ulva lobata belongs to the same group of species as *U. expansa,* but is generally firmer in substance, slightly thicker, never reaches a great size, and is less deeply or conspicuously ruffled. It is well represented by the specimens distributed in the Phycotheca Boreali-Americana (under no. 863).

The most typical plants are those of the central Californian coast (San Francisco to Monterey). We have referred here, also, one plant from southern California, but with some doubt.

Ulva expansa (Setchell) comb. nov.

Frond ample, pale green, orbicular or broadly elongated, margin deeply ruffled; frond 60–70μ thick in the middle, 38–45μ on the margins; cells, in section, vertically elongated in the middle of the frond (up to 28–30μ long, 10–12μ wide), nearly square in the margins.

Growing on rocks in the lower littoral belt. Puget Sound, Washington, to Mexico (La Paz).

Ulva fasciata f. *expansa* Setchell, *in* Collins, Holden and Setchell, Phyc. Bor.-Amer. (Exsicc.), no. LXXVII; Collins, Green Alg. N. A., 1909, p. 216.

We find along the coast of central California a broad species of *Ulva,* often also long, something like *Ulva latissima* in appearance, yet of a more vivid green color, thicker in the center of the frond and with distinct, broad, ruffled margins. The cells of the thicker center of the frond are distinctly palisade-like in section, while on the thinner

margins they are nearly square. A younger specimen of this plant was distributed by one of us as *Ulva fasciata* f. *expansa* (Phyc. Bor.-Amer., no. LXXVII), but it has seemed, on further study, to belong neither to *Ulva fasciata* Delile nor to the *Ulva fasciata* f. *taeniata* also distributed by one of us (Phyc. Bor.-Amer., no. 809), but described later on in this account as *Ulva taeniata*. We, therefore, describe it as an independent species under the name of *Ulva expansa*.

Ulva expansa, so far as we have observed it, remains attached only for a short time. It soon becomes free and floats or drifts, increasing in size, becoming at times at least 3 M. long and varying in width from 18 cm. to 75 cm. In form and structure it differs from *Ulva latissima* and from all the other species of *Ulva* of our coasts. It comes nearest to *Ulva fenestrata*, as we have described that species, but is little, if at all, perforate. Plants of what appears to be the same species have been found in the Puget Sound region and Howe (1911, p. 490) is inclined to credit here some from La Paz, Mexico.

Ulva dactylifera sp. nov.

Plate 26, figure 1

Thallo sessili aut stipite brevi suffulto; parte basali obovata aut reniformi, crispatissimo, 2–4 cm. alto, e margine superiore 1–6 lobos aut lacinias, simplices aut sparse ramosos et costam definitam ostendentes et marginibus crispatissimis instructos producente, 5–15 cm. high, 0.5–1.5 cm. wide; membrana basali ad marginem 50μ ad medium usque ad 100μ crassa, cellulis e superficie 16–20μ diam. sectione transversali quadratis usque ad 2-plo diam, longioribus; membrana laciniarum marginibus 40–50μ crassa, medio usque ad 190μ crassa, cellulis e superficie 12–16μ diam., sectione transversali quadratis usque ad 5-plo diam. longiores; chromatophoris dimidium externum cellularum implentibus.

Frond sessile or with a very short stipe; basal portion orbicular or reniform, much crisped, 2–4 cm. high, giving rise from the upper margin to 1–6 lanceolate, simple or occasionally branched lobes or laciniae with plane midrib, and much crisped margins, 5–15 cm. high, 0.5–1.5 cm. wide; membrane of basal portion 50μ thick at the margin, up to 100μ thick in the middle, with cells 16–20μ diam. in the surface view, quadrate to 2 times as long as wide in section, membrane of the laciniae 40–50μ thick on margin, up to 190μ thick in the middle, with cells 12–16μ diam. in surface view, quadrate to 5 times as long as wide in section; chromatophore filling the outer half of the cell.

On exposed rocks, uppermost littoral belt. Southern California to Mexico (San Roque?). Type no. 1988, Gardner.

We have along the Californian coast two species related to *Ulva fasciata*, neither of which seems to be exactly like the Mediterranean

species. Both are characterized by long, narrow fronds or laciniae, much thicker along the middle and with thinner, very much crisped margins. One of these, *Ulva dactylifera*, possesses a comparatively broad, though short, undivided basal portion from which arise the several, narrow, elongated, crisped laciniae. Neither the basal portion nor the laciniae show distinctly toothed margins. The other species, *Ulva taeniata*, is either simple, long, slender, plane and dentate below, but with crisped margins above, or divided to the very disk itself into two or three such divisions. The "midrib" portions differ slightly in thickness in the two species and the cells of the "midribs" differ in proportions.

Ulva dactylifera has been distributed under no. 221*b* (sub "*Ulva fasciata*") of the Phycotheca Boreali-Americana. Unfortunately the plants under this number are not uniform. We have examined no. 221*b* in two copies. In one the plant is certainly, although not typically, *U. dactylifera*. In the other it seems rather to be a form of *Ulva Lactuca*.

Ulva dactylifera is nearest to *U. fasciata* f. *costata* Howe (1914, p. 20, pls. 1, 2, figs. 10–23), but differs as to the basal portion, thickness, and possibly also in proportions of cells. It differs from *U. fasciata* Delile, so far as descriptions and figures indicate, in branching, in ruffling, and probably in thickness. It is a very much thinner plant than *U. nematoidea* Bory, judging from the dimensions given by Bornet (1892, p. 36 or 196).

Ulva taeniata (Setchell) comb. nov.

Plate 28

Frond elongated, up to 1 to 2 M. long, simple or split to the very base into long, narrow segments, plane below and coarsely dentate, densely crisped and ruffled on the margins above, with a plane, thicker midrib; membrane up to 140μ thick as to the midrib, and down to 40μ thick on the margins; cells of the midrib vertically elongated, in section, up to two and one-half times as high as broad, but becoming nearly square towards the margins.

On rocks in the lowermost littoral or upper sublittoral belts. Central California (Tomales Bay to Monterey.)

Ulva fasciata f. *taeniata* Setchell, *in* Collins, Holden and Setchell, Phyc. Bor.-Amer. (Exsicc.), no. 862; Collins, Green Alg. N. A., 1909, p. 216.

Ulva taeniata has been found thus far on the coast of central California only, while *U. dactylifera* has been found only on that of southern California. The differences between the two have been enumerated under the latter species. From *U. fasciata* f. *costata* Howe it differs particularly in its basal portion. *Ulva fasciata* Delile seems to be a species nearly if not absolutely plane, while *U. taeniata* is always crisply ruffled. No. 862 of the Phycotheca Boreali-Americana represents this species very well.

Prasiola

There are eight species of *Prasiola* at present accredited to the territory of the Pacific Coast of North America. One of these, *Prasiola crispa* (Lightf.) Menegh., is, we believe, strictly terrestrial, at least so far as our territory is concerned. Another, *P. calophylla* (Carmich.) Menegh., is also terrestrial, but found with us in a marine locality. Three species, *P. borealis* Reed, *P. meridionalis* sp. nov., and *P. delicata* sp. nov., are strictly marine. One species, *P. Gardneri* Collins, has been removed to the genus *Merismopedia* (*M. Gardneri* Setchell), while three species, *P. fluviatilis* (Sommerf.) Aresch., *P. mexicana* J. Ag., and *P. nevadensis* sp. nov., are inhabitants of cold fresh-water streams.

Prasiola mexicana J. Ag. (1847, p. 6) is based upon specimens collected in Mexico by Professor Liebmann of Copenhagen. The type locality is Santa Maria Alpatlachna in Mexico. The habitat is turbulent mountain streams. The habit is that of a broad plant, umbilicate at the base and laciniate and irregularly crispate. Agardh simply adds that the areolae are regularly quaternate. No mention is made of the presence of intercellular lines, "*viae interstitiales*," in this first description. Jessen (1848, pp. 19, 20, pl. 1, figs. 17–20) gave a more ample description and illustrations from materials and information provided by Liebmann. Lagerstedt (1869, p. 26) redescribed the species, but drew his information largely, if not entirely, from Bolivian specimens. J. G. Agardh (1882, p. 84) added nothing in his final review of the genus *Prasiola*.

Thus far the specimens from our mountain streams have all been referred to *Prasiola mexicana* J. Ag. (1847, p. 6), a species with broad fronds, umbilicate or nearly so at the base, and arising from a disk, possibly later developing secondary rhizoidal outgrowths of attachment on the decumbent base. The color is dark green and the laciniae

have crisped or ruffled edges. This description is taken largely from Jessen (1848, p. 19, pl. 1, figs. 17–20), who, as noted above, received his materials from the type collection directly from Liebmann, the original collector. Unfortunately we have not been able to examine any of the type material and, consequently, must judge our plants entirely from the point of view of the descriptions and figures. From this point of view it seems safe to refer most of the various specimens accessible to us to *P. mexicana*.

Under *Prasiola mexicana* have thus been referred specimens from Montana (Tilden, Amer. Alg., no. 129), Wyoming (Tilden, *loc. cit.*, no. 555*a*) and Oregon (Tilden, *loc. cit.*, no. 555*b*, and Collins, Holden and Setchell, Phyc. Bor.-Amer., no. 1186). The species is represented in the Herbarium of the University of California by specimens from Washington (no. 132922, collected by Professor T. C. Frye in the Ehoha River in the Olympic Mountains), from Oregon (no. 98182, from McCleary Canyon near Portland, collected by A. S. Foster; nos. 98181 and 98183, collected near Eugene and near Forest Grove respectively by Professor A. R. Sweetser), while in California it has been collected in Crane Creek above El Portal at an altitude of 4000-4500 feet (Gardner, no. 4466). It is reported by Wolle (1887, p. 107, pl. 91, fig. 24) from Colorado, where it was collected by T. S. Brandegee. It has also been collected in the Diamond range of mountains in eastern Nevada, where it was found by Sereno Watson and described by Horatio C. Wood (1871, p. 415, 1873, p. 182) under the name of *Ulva merismopedioides*. A portion of the type (or cotype) has been examined and there seems little question as to the identity of Wood's species and those we are assigning to *Prasiola mexicana* J. Ag. The fragment of the type examined and from which our figures (cf. pl. 21, figs. 8–10) are drawn for comparison was communicated to us by Frank S. Collins, having been received by him from the United States National Herbarium. Collins (1903, p. 17) placed the *Ulva merismopedioides* Wood under *Monostroma quaternarium*, but later, as he writes us, made a second examination of the material and found something seemingly different from what he had examined previously and upon which he had based his opinion. The fragment examined by us is clearly *Prasiola mexicana* as we understand that species. The cross-section of Wood's plant, however, differs from the description of Wood in that the cells (cf. Wood, 1873, p. 182) are not in a single layer, but in two to several, as a glance at our illustrations (cf. pl. 21, figs. 9, 10) will show.

In connection with cross-sections of *Prasiola mexicana,* it may be said that the various specimens agree very well as to the number and arrangement of cells but differ somewhat in width of section. In width the sections vary from 24μ to 52μ, but the increase in thickness is more or less associated with the development of the so-called aplanospores. We find these arising in greater numbers from a single cell than any description thus far indicates for any species of *Prasiola.* Lagerheim has described and figured them for *Prasiola mexicana* var. *quitensis* Lagerheim (1892, pp. 370–372, pl. 20, figs. 15–22). He found either a single layer of tetrads (*loc. cit.*, fig. 18) or two layers of tetrads (*loc. cit.*, fig. 20) in the membranes of his variety. In our specimens we find the double row of tetrads (cf. pl. 21, figs. 3–7), and also double rows of tetrads intermingled with groups where the horizontal divisions have proceeded farther, as they do in antheridial formation in certain species of *Porphyra.* The majority of sections show the two kinds (or stages in development) of these bodies intermingled. We feel it necessary to consider these bodies as aplanospores until further investigation can shed more light as to their fate, but the resemblance between them and the species of *Porphyra,* as well as the resemblances in cell structure, particularly as regards the shape and position of the chromatophore, suggests strongly the possibility of a nearer relation to the Bangiales than to the Ulvales and a remote (?) possibility that we may be dealing here with antheridia and a very simple type of cystocarp.

Comparing our specimens with the descriptions and figures of Agardh and Jessen, we believe them to be true *Prasiola mexicana,* and comparing them with Lagerheim's descriptions and figures we are inclined to agree with him that the Equador plant is different, possibly even specifically.

One of us (Setchell) has found a *Prasiola* in Crane Creek (Mariposa County, California), between Big Meadow and McCauley's, which differs so much from *P. mexicana* that it seems desirable to describe it as new. It differs from *P. mexicana* in habit, color, and structure. It is always elongated (cf. pl. 21, figs. 11–13), while *P. mexicana* is broad and umbilicate. In color it is light, almost yellow-green, instead of the darker green characteristic of *P. mexicana.* In surface view (cf. pl. 21, figs. 14–16) the smaller groups of cells are more distinctly placed and are further marked off into areas by delicate lines (or borders) in the enclosing jelly. The sections (cf. pl. 21, figs. 17, 18) are as broad as the narrower sections of *P. mexicana,* being 17μ to 25μ

or 26μ wide. The aplanospores form a simple series of tetrads only and show no disposition to proceed further. On account of these differences it seems best to describe these plants as belonging to a new species, *Prasiola nevadensis*. It is to be recorded and is of decided significance in this connection that the other one of us (Gardner) has collected characteristic *Prasiola mexicana* in the same stretch of the same stream, at the same season but in a different year. It may be, therefore, that our new species may be found to be included among the stages in the development of, or states of, *P. mexicana*. It seems so distinct, however, that we venture to describe it as new and specimens will be distributed in a fascicle of the Phycotheca Boreali-Americana soon to be issued.

Prasiola nevadensis comes much nearer to *P. fluviatilis* (Sommerf.) Aresch. than to *P. mexicana*. It differs from *P. fluviatilis* so far as we may determine from descriptions, figures and scanty specimens available to us, in being broader and not tapering regularly from above toward the base. We do not know much about the structure of *P. fluviatilis*, but suspect that the general character and arrangement of cells may closely resemble those of our *P. nevadensis*. Our plant may be closer to *P. fluviatilis* var. *Hausmanni* Grun., in that it is a broader species than typical *P. fluviatilis*, but further comparison is impossible. We append the following diagnosis:

Prasiola nevadensis sp. nov.

Plate 21, figures 11–18

Thallis gregariis, angustis, 2–3 cm. longis, 0.5–1 cm. latis, oblongis usque ad oblanceolatis, e basibus latis oriundis, primo disco minuto, aetate provecta, rhizoidibus e basi decumbente emissis affixis, dilute viridibus, marginibus undulatis et crispatissimis; membrana 14–25μ crassa; cellulis in gregibus parvis e superficie visis quaternis, rotundis aut angulatis, laxe positis et in areolas indistinctas segregatis, in sectione transversali rotundis usque ad valliformibus; viis interstitialibus distinctis nullis; aplanosporis in serie singula, quaternis.

Thalli gregarious, narrow, 2–3 cm. long, 0.5–1 cm. wide, oblong to oblanceolate, from a broad base, attached at first by a small disk, later by rhizoids from the basal portion, pale green, with margins undulate and very much crisped; membrane 14–25μ thick; cells in small groups of tetrads as seen from the surface, rounded or angular, loosely placed, forming indistinct areoles, but without interstitial lines, cells in transverse section rounded to elongated vertically; aplanospores (?) in a single layer of tetrads.

In rapid waters of Crane Creek, Foresta townsite, Mariposa County, California, at 3500–4000 feet altitude. Type no. 6507, Setchell.

PLATE 22

Ulva angusta S. and G.

A photograph of a group of plants, the type.

Prasiola meridionalis sp. nov.

Plate 25, figure 2

Thallo usque ad 7 mm. alto, stipiti brevi latoque in laminam latam, cordatam et rosulatam aut cucullatam abeunte, sordide viridi; cellulis neque in areolis distinctis ordinatis neque per vias interstitiales separatis; membrana 40–45μ crassa, in sectione transversali cellulas 14–18μ altas et 7–8μ latas marginibus latis hyalinisque (usque ad 13μ crassis) ostendente; akinetis dispersis, magnis, parietibus crassis; aplanosporis probabiliter 128–512 ($4 \times 4 \times 8$ aut $8 \times 8 \times 8$) in aplanosporangio singulo.

Frond up to 7 mm. high, with short and broad stipe, soon expanded into a broad, cordate, rosulate or cucullate blade, dirty green; cells neither arranged in distinct areolae nor separated by interstitial lines; membrane 40–45μ thick, section showing cells 14–18μ high and 7–8μ wide with broad hyaline margins (up to 13μ thick); akinetes scattered, large, thick walled; aplanospores probably 128–512 ($4 \times 4 \times 8$ or $8 \times 8 \times 8$) from a single aplanosporangium.

On exposed rocks or rocky islets above the high-water mark but exposed to the force of the waves. Washington (Friday Harbor and Neah Bay) to central California (entrance to Tomales Bay). Type no. 3824, Gardner.

The specimens taken as the type of this species were collected by one of us (Gardner) at Neah Bay, Washington. We are also inclined to refer here specimens collected at "Minnesota Reef" at Friday Harbor, Washington, and at the entrance to Tomales Bay, California. In the last two localities the species is associated with *Gayella constricta*. Cultures, however, strongly indicate the independence of the two plants from one another.

Prasiola meridionalis comes near to *P. borealis* Reed, but the frond of the latter is areolate and with more or less distinct intercellular lines. *P. borealis* is, so far as found, infested with a fungus (*Guignardia alaskana* Reed), while none of the three collections of *P. meridionalis* shows any trace of such a parasite.

Prasiola delicata sp. nov.

Plate 22, figure 3*a-f*, and plate 25, figure 1, and plate 24, figure 8

Thallo 1–1.5 mm. alto, lato et breviter stipitato, in laminam late oblongam aut cordatam expanso, marginibus crispatis et involutis, atro-cyaneoviridi; membrana 17–20μ crassa, cellulis neque in areolas distinctas ordinatis neque per vias interstitiales separatis; akinetis non visis; aplanosporis usque ad 512 e cellula singula ($8 \times 8 \times 8$) sed frequenter tantum 128; cellulis valliformibus, in sectione transversali verticaliter 10–12μ, 2-plo aut ultra diam. longioribus.

Frond 1–1.5 mm. high, broad and shortly stipitate, expanding directly and abruptly to broadly oblong or cordate, margins crisped and inrolled, dark bluish green; membrane 17–20μ thick, cells not grouped into distinct areolae and not separated by interstitial lines; akinetes not seen; aplanospores up to 512 from a single cell ($8 \times 8 \times 8$), but often only 128; cells palisade-like and 10–12μ in vertical diameter, in section twice or more times as high as broad.

Growing at or near the upper tide mark on rocky islets. Sitka, Alaska. Type no. 3981, Gardner.

Prasiola delicata has a decidedly thinner membrane than any other of our marine species, shows little areolation, and has a larger number of aplanospores formed within a single aplanosporangium. These characters seem to indicate its just claim to be considered a distinct species.

Entocladia cingens sp. nov.

Plate 23, figure 7

Thallo textum pseudoparenchymaticum filamenta hospitis cingens et intus membranam, sed filamenta marginalia ad longitudinem hospitis parallela ostendens mox formante; cellulis centralibus fere isodiametricis, 5–8μ diam., tardiore augescentibus et in sporangia transformatis; cellulis filamentorum liberorum marginalium 3–4μ diam., 2–3-plo diam. longioribus, terminalibus longis, conicis.

Thallus early forming a pseudoparenchymatous tissue surrounding the filaments of the host within the membrane, having a few marginal filaments extending parallel with the long diameter of the host; cells in the center of the thallus nearly isodiametric, 5–8μ diam., enlarging later to form sporangia; cells of the free marginal filaments 3–4μ diam., 2–3 times as long as the diameter, terminal cells long, conical.

Growing within the membrane of *Chaetomorpha californica* Wille. Southern California (Ocean Beach, near San Diego), December. Type no. 3528*a*, Gardner.

The plants of this species seem to be nearing maturity in December, since a few empty cells in the center of the thallus were found from which reproductive bodies probably had escaped. Aside from this condition, nothing further is known of its method of reproduction.

Entocladia cingens is placed in this genus on account of the resemblance of the vegetative development to that of the type species, *E. viridis* Reinke, and because it has the same endophptic habit as has that species. It differs from *E. viridis* in having the branching filaments more closely coalescent, the enlarging cells in the main part of the thallus soon forming a pseudoparenchymatous tissue, leaving only a few free marginal filaments.

E. viridis, E. codicola, and *E. cingens* form a well connected series, using the vegetative characters as a basis. The first named species has a rather wide spreading thallus, composed of relatively sparsely branching filaments, scarcely, if at all, coalescing in the center. In the second the filaments coalesce freely in the center so that at least half of the thallus is formed into a pseudoparenchymatous tissue at the time of reproduction, but leaving an abundance of free branching marginal filaments. The thallus of the third is almost wholly transformed into a pseudoparenchymatous tissue at maturity leaving only a few free marginal filaments.

Entocladia codicola sp. nov.

Plate 24, figures 7*a*, 7*b*

Filamentis laete viridibus, profuse ramosis, maturitate stratum continuum centrale ad peripheriam terminos liberos et attenuatos exhibens formantibus; cellulis juvenis 3–4μ diam., 1–2.5-plo diam. longioribus, terminantibus gracilibus et conicis; cellulis thalli centralibus 5–8μ diam.; pyrenoidibus singulis; generatione ignota.

Filaments light green, branching profusely, at maturity forming a continuous layer in the center of the mass with many tapering free ends around the margin; young cells 3–4μ diam., 1–2.5 times as long, terminal cells slender and conical; cells in the center of the thallus 5–8μ diam.; pyrenoid single; reproduction unknown.

Growing in the membrane, at the tips of the utricles of *Codium fragile*. Central and southern California. Type no. 4121, Gardner.

Entocladia codicola seems closely related to *Entocladia viridis* Reinke (1879, p. 476, pl. VI, figs. 6–9), found growing in the membrane of *Derbesia;* but it is a larger plant with the filaments much more compact in the center, forming in fact a pseudoparenchymatous disk with free filaments around the margin. The cells are shorter than those of *E. viridis,* some being even shorter than the diameter. In the pseudoparenchymatous character of the center of the disk-like frond it resembles *Entocladia Flustrae* Reinke (1888, p. 241, nomen nudum, 1889, p. 31, pl. XXIV, 1889*a*, p. 86), but the dimensions given for that species are in general greater than those in ours. Reproductive bodies have been observed in the cells of the central portion of the disk in *E. codicola,* but the nature of these, their method of escape, and their subsequent behavior have not been determined. Until more is known concerning these later phases of the plant, its proper placing must remain somewhat in doubt. It is here provisionally placed with *Entocladia* on account of its endophytic habit of growth,

rather than with *Epicladia,* which has the habit of growing on the outside of the host. This habit of growth seems to be the only one by which the two genera are distinguished as far as the diagnoses reveal. Little, however, is known concerning the reproduction in *Epicladia,* and until the matter can be cleared up it can have but little claim to generic distinction. Reinke expressed doubt as to the validity of the genus when he diagnosed it (1889). Collins (1909) has retained both genera, and under *Endoderma* (*Entocladia*) has included two species, viz., *E. pithophorae* West and *E. polymorphum* West, which are epiphytic, and thus, as he remarks (*loc. cit.,* p. 280), "connects *Endoderma* with *Epicladia,* but the filaments do not unite to form a definite disk."

Entocladia codicola seems to be confined to the coast of California and to the above mentioned host plant, at least, examination of considerable material of different species of *Codium* in different localities ranging from Sitka, Alaska, to southern California has not revealed its presence elsewhere.

Internoretia gen. nov.

Thallus endophyticus, e filamentis profuse ramosis, primo cellulis in serie simplici per divisiones apicales verticaliter ad longitudinem positas augescentibus, tardiore per divisiones obliquas et longitudinales, filamenta cylindrica cellulis numerosis composita formantibus; filamenta ramos ad angulos rectos emittentia, ramis anastomosantibus; chromatophora parietalis, pyrenoidibus singulis; generatio ignota.

Thallus endophytic, consisting of profusely branched filaments, at first of a single series of cells increasing by apical divisions perpendicular to the long diameter, but later by oblique and longitudinal divisions, building up cylindrical threads composed of numerous cells in cross diameter; branching at right angles, anastomosing, forming a network; chromatophore parietal, with one pyrenoid; reproduction unknown.

The genus *Internoretia* is proposed for a peculiar endophyte found by Professor T. C. Frye, growing within the membranes of *Porphyra Naiadum.* Its reproduction not having been determined, it is among the numerous form-genera of uncertain position and placed provisionally among the Chaetophoraceae. It resembles *Pseudodictyon* Gardner and *Zygomitus* B. and F. From the former it differs in forming solid filaments several cells in thickness. From *Zygomitus, Internoretia* differs in the greater regularity of its solid portions and in the more uniform network brought about by the regular giving off of branches at right angles.

Internoretia Fryeana sp. nov.

Plate 23, figures 3–6

Cellulis filamentorum terminalium 3.5–5μ diam., 3–5-plo diam. longioribus, apicalibus conicis; cellulis partium thallorum vetustiorum isodiametricis, angularibus; aliter ut in generi.

Cells of the terminal filaments 3.5–5μ diam., 3–5 times as long, apical cell conical; cells of the older part of the thallus isodiametric, angular; otherwise as the genus.

Growing within the membrane of *Porphyra Naiadum.* Friday Harbor, Washington, July. Type no. 4260, Gardner.

This most interesting little plant is as yet known only from the collections and observations of Professor T. C. Frye. It generally occurs in such abundance as to discolor the host plant. In some years it is very common, discoloring most of the plants of *Porphyra* in the neighborhood of the Puget Sound Marine Station, while in other years it is difficult to find any plants at all.

Pseudulvella prostrata (Gardner) comb. nov.

Growing on the basal portion of *Iridaea laminarioides.* Central California (Lands End, San Francisco).

Ulvella prostrata Gardner, New Chlorophyceae, 1909, p. 373, pl. 14, figs. 1, 2; Collins, Green Alg. N. A., 1909, p. 287; Collins, Holden and Setchell, Phyc. Bor.-Amer. (Exsicc.), no. 1629.

Recent observation has revealed the presence of a pyrenoid in each cell of the plant under consideration, a character not belonging to the genus *Ulvella.* This character militates against placing it in that genus. As found growing on *Iridaea,* it has no penetrating rhizoids, thus differing in this respect from the genus *Pseudopringsheimia,* to which it seems closely related. Nothing has yet been learned regarding reproduction. Considered in the light of our present knowledge, *Pseudulvella* seems to be the genus most appropriate for its reception.

Pseudulvella applanata sp. nov.

Thallo tenui parenchymatico, per incrementum marginale ad mm. plura augescente, laevi et nitido, 45–55μ crasso, laete viridi; cellulis in series verticales, proxime regulares positis, proxime isodiameitricis, acute angulatis, 6–7.5μ diam.; chromatophoris parietem cellularum tegentibus, pyrenoidibus singulis; zoosporangiis (?) e cellulis superficialibus leviter transformatis oriundis; generatione ignota.

Thallus thin, parenchymatous, spreading by marginal growth, expanded to several mm. in diam., smooth and glossy, 45–55μ thick; color grass green; cells in fairly regular vertical rows nearly isodia-

metric, sharply angled, 6–7.5μ diam.; chromatophore covering the cell wall provided with one pyrenoid; zoosporangia (?) slightly modified surface cells; reproduction unknown.

Growing on the shells of *Littorina planaxis* Nutt. Central California. Type no. 3597, Gardner.

Littorina planaxis Nutt. is very abundant in small tide pools and in moist places along high-tide level from Sitka to San Diego. *Pseudulvella applanata* has been studied only on material found along the coast of central California, but it is presumed to have a much wider distribution.

Its presence on the host is readily recognizable by the expanded, grass green, glossy appearance of the surface of the shell. Microscopically it may readily be distinguished from all other described species of the genus by its very small, closely compact, parenchymatous cells, and the seeming absence of radiating filaments composing the basal layer. It spreads over the host by tangential and by radial divisions of the peripheral cells, at least the process can thus be described when the plant is of considerable size. It probably starts on the very young host, and doubtless many plants early coalesce to form a confluent thallus. We have not been able to ascertain the nature of the early developmental stages, although very small shells have been examined.

Reproductive bodies have been seen to escape from the surface cells. Whether these are zoospores or gametes, the number of cilia they possess and their behavior after escaping are subjects for further investigation.

The three species of Pseudulvella known from the western coast of North America may be arranged, so far as the basal layer is concerned, in the following sequence: *P. prostrata,* with distinctly radiating basal filaments which branch rather frequently and which are comparatively loosely coalescent; *P. consociata,* with indistinctly radiating basal filaments closely coalescent; and *P. applanata* with a parenchymatous basal layer.

Pseudulvella consociata sp. nov.

Plate 24, figures 4–6

Thallo magnitudine et peripheria irregulari, 100–140μ crasso, per filamenta irregularia et radiantia augescente; filamentis mox coalescentibus et parenchymaticis, atroviridi; filamentis erectis dense adhaerentibus, 7–10μ diam., cellulis prope cylindricis, forma leviter irregularibus, 1–2-plo diam. longioribus; zoosporangiis (?) terminalibus, pyriformibus usque ad sphaericis, 8 zoosporas emittentibus.

Gomontia Bornetii nom. nov. page 297

Horizontal filaments irregular, much branched, erect filaments with clavate ends, less branched; cells 4–12μ, most frequently 6μ diam., 15–55μ long, cylindrical to more or less swollen and crooked; "sporangia" variable and irregular in form, 8–125μ wide, 150–200μ long, having numerous, mostly simple rhizoids arising principally on one side but occasionally promiscuously scattered all over the sporangia; zoospores of two sorts, one 3.5μ wide and 5μ long, the other 5–6μ wide and 10–12μ long, development unknown; aplanospores 4μ diam.

cells are to be designated as such. Those of *P. conjunens* are long and comparatively narrow, and produce 30 to 40 zoospores, while in *P. apiculata* they are shorter, somewhat swollen, mostly with a pronounced terminal projection, and produce about 8 zoospores. These reproductive bodies are very small and it is exceedingly difficult to determine their number of cilia. On one occasion four cilia were observed, but the reproductive bodies seemed a little larger and somewhat more irregular in form than the average. These may have been the zygotes which had been formed by the fusion of 2-ciliated gametes and which had not yet come to rest.

Growing in clam shells. Neah Bay, Washington.

Gomontia polyrhiza Bornet and Flahault, Notes sur deux nouveaux genres d'algues perforantes, 1888, pp. 161–163 (not *Codiolum polyrhiza* Lagerheim).

Bornet and Flahault (1889, p. 9) distinctly state that the greatest dimensions of the "sporangia" in their specimens are 120μ for height and 75μ for width, and mention that Lagerheim found "sporangia" in the specimens up to 240μ in height and 60μ in breadth. We judge, therefore, that the *Codiolum*-type of "sporangium" which Lagerheim figures (1885, pl. 28, figs. 10, 11 in particular) and describes (*"plerumque plus minus elongatis," loc. cit.,* p. 22) was not to be found in the French material and certainly is not illustrated by Bornet and Flahault, unless figure 9 on plate 7 may represent it. The type of "sporangium" illustrated by Bornet and Flahault (1889, pls. 7, 8) belongs to the shorter and broader type, the Acarid-type as it may be called, and has blunt, simple or slightly branched rhizoids. Lagerheim (*loc. cit.,* pl. 28, figs. 7, 8, 12, 13) has also figured "sporangia" of the Acarid-type and probably found a mixture of species in the shells he examined. Since, however, he emphasizes the elongated, or *Codiolum,* type of sporangia, it seems best to reserve his specific name for the species with the *Codiolum*-type of "sporangium" and assign the new specific name (*Bornetii*) to the species having the Acarid-type of "sporangium" and with blunt, rather stout, simple or, at most, slightly branched rhizoids.

The filaments of *G. Bornetii* are well represented by Bornet and Flahault (1889, pl. 6, figs. 1–8) and by their usually large number of short, blunt or almost bulbously enlarged branchlets and their compact massing make a characteristic appearance after decalcification. They are very similar to those of *G. polyrhiza,* as far as we can determine, but somewhat different from those of *G. habrorhiza,* although this difference is not readily described.

While we find what seems referable to *G. Bornetii* in the Puget Sound region and that of central California, we desire more abundant and more decisive material before we can determine this.

Gomontia habrorhiza sp. nov.

Plate 24, figures 2, 3*a*, 3*b*, 3*c*

Filamentis repetite et irregulariter ramosis; cellulis forma magnitudineque maxime variabilibus, typice cylindricis, 4–7μ diam., 2–8-plo diam. longioribus, chromatophoris pyrenoidibus destitutis, cellulam totam implentibus; "sproangiis" (gametangiis ? aut aplanosporangiis ?) angustis aut latis, obtuse conicis, 50–70μ altis, 25–60μ latis, in

latere inferno rhizoidibus multis gracillimis, attenuatis et dendritice ramosis indutis; generatione ignota.

Filaments repeatedly and irregularly branched; cells very variable in form and size, typically cylindrical, 4–7μ diam., 2–8 times as long; chromatophore without pyrenoids, filling the cell; "sporangia" narrow to wide, bluntly conical, 50–70μ high, 25–60μ wide, developing many very slender, attenuate, dendritically branched rhizoids from the lower side; reproduction unknown.

Growing on dead clam shells. Neah Bay, Washington. Type no. 3825, Gardner.

In a *Gomontia* inhabiting certain shells from Neah Bay we have found all the "sporangia" of the Acarid-type and with the processes or rhizoids slender, branched, and attenuated to a point. The "sporangia" seem so distinct from those of *G. Bornetii* that we describe the plant possessing them as new. In some shells we have found the "sporangia" of this species intermingled with others. The vegetative filaments of *G. habrorhiza* seem less entangled and slightly larger than those of either *G. polyrhiza* or *G. Bornetii*.

Gomontia caudata sp. nov.

Plate 23, figures 1, 2

Filamentis brevibus, parce ramosis; cellulis 5.5–6.5μ diam., 2–12-plo diam. longioribus; chromatophoris cellulas terminales et "sporangia" juvena implentibus, in cellulis vetustioribus interruptis; pyrenoidibus inconspicuis; "sporangiis" (gametangiis ? aut aplanosporangiis ?) clavatis, 50–70μ latis, 160–200μ longis, inferne ad rhizoide singula attenuatis, parietibus maturitate crassis, hyalinis, homogeneis; rhizoidibus saepe maxime inerassatis striatisque.

Filaments short, sparsely branched; cells 5.5–6.5μ diam., 2–12 times as long; chromatophore covering the terminal cells and young "sporangia," broken in the older cells; pyrenoids inconspicuous; "sporangia" clavate, 50–70μ diam., 160–200μ long, tapering to a single rhizoid below with thick, hyaline, homogeneous wall at maturity; rhizoid often becoming much thickened and striated.

Growing in shells of *Mytilus californicus* Conr. Neah Bay, Washington. Type no. 3825, Gardner.

We have found in shells of the larger edible mussel of our coast a *Gomontia* with filaments seemingly less abundantly branched and "sporangia" (aplanosporangia ?) with very thick walls and a single long rhizoid (cf. pl. 23, figs. 1, 2). These "sporangia" bear a certain resemblance to the "cells" figured by Lagerheim (1885, pl. 28, figs. 4, 6), but are, at least, thicker walled. The fact which seemed to indicate distinctness was that only this type of "sporangium" was found in the shells examined.

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PLATE 21

Prasiola mexicana J. Ag.

Herb. Univ. Calif., no. 91181, collected near Eugene, Oregon, by Professor A. R. Sweetser, May, 1903.

Fig. 1. Habit of typical plant. × 0.5.

Fig. 2. Surface view of thallus lobe. × 375.

Fig. 3. Transverse section showing double layer of tetrad-type of aplanospore (?) formation. × 375.

Fig. 4. Similar section showing both tetrad and "antheridial" type of aplanospore (?) formation. × 375.

Fig. 5. Similar section to that of figure 3, but less regular. × 375.

Herb. Univ. Calif., no. 91182, collected near Portland, Oregon, by H. A. Foster.

Fig. 6. Transverse section showing single layer of tetrad-type of aplanospore (?) formation. × 375.

Fig. 7. Transverse section showing "antheridial" type of aplanospore (?) formation. × 375.

No. 1545, U. S. Geol. Surv., collected in the Diamond Range, Nevada, by Sereno Watson and type collection of *Ulva merismopedioides* Wood.

Fig. 8. Surface view of lobe of thallus. × 375.

Fig. 9. Transerve section showing double layer of tetrad-type of aplanospore (?) formation. × 375.

Fig. 10. Similar section showing "antheridial" type of aplanospore (?) formation. × 375.

Prasiola nevadensis S. and G.

No. 6507, collected in Crane Creek, Foresta townsite, Mariposa County, California, by W. A. Setchell, June, 1914.

Fig. 11. Habit of young plant. × 0.5.

Fig. 12. Habit of young plant. × 0.5.

Fig. 13. Habit of older plant. × 1.

Fig. 14. Surface view of lobe of thallus. × 375.

Fig. 15. Surface view of lobe of thallus. × 375.

Fig. 16. Surface view of portion of thallus. × 375.

Fig. 17. Transverse section showing cells probably on the way to aplanospore (?) formation. × 375.

Fig. 18. Similar section showing tetrad-type of aplanospore(?) formation. × 375.

All the figures of this plate were drawn by Dr. Helen M. Gilkey under the direction of W. A. Setchell.

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